

WHAT IS CLAIMED IS:

1. A vehicle driving force control apparatus for a vehicle having a clutch installed in a torque transfer path from a drive source to a wheel, the clutch having an input part connected to the drive source and an output part connected to the wheel, the vehicle driving force control apparatus comprising:
 - an output rotational speed sensor configured to detect an output rotational speed of the output part of the clutch and produce an output rotational speed value;
 - an input rotational speed sensor configured to detect an input rotational speed of the input part of the clutch and produce an input rotational speed value;
 - 10 an output stop estimating section configured to estimate that rotation of the output part has stopped rotating upon an occurrence of a detected first parameter that is based on the output rotational speed value received from the output rotational speed sensor;
 - 15 an input stop estimating section configured to estimate that rotation of the input part has stopped rotating upon an occurrence of a detected second parameter that is based on the input rotational speed value received from the input rotational speed sensor;
 - a vehicle stop determining section configured to a determination whether the vehicle has stopped;
 - 20 a clutch stop determining section configured to determine that the clutch has stopped rotating based on a determination of the occurrences of the detected output and input parameters, upon the vehicle stop determining section determining that the vehicle has stopped; and
 - a clutch connection command outputting section configured to output a clutch connection command to connect the clutch, upon the clutch stop determining section determining that the clutch has stopped rotating.
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2. The vehicle driving force control apparatus according to claim 1, wherein the output stop estimating section is further configured such that the detected first parameter is a first amount of time that is an estimated of time for the output part to stop rotating based on the output rotational speed value received from the output rotational speed sensor;

the input stop estimating section is further configured such that the detected second parameter is a second amount of time that is an estimated of time for the input part to stop rotating based on the input rotational speed value received from the input rotational speed sensor; and

5 the clutch stop determining section is further configured such that the clutch has been determined to have stopped rotating based on the first and second amounts of time estimated by the output and input stop estimating sections having elapsed, upon the vehicle stop determining section determining that the vehicle has stopped.

10 3. The vehicle driving force control apparatus according to claim 2, wherein the vehicle stop determining section further configured to determine that the vehicle has stopped rotating if the output rotational speed value of the output part falls below a minimum detectable rotational speed for the output rotational speed sensor.

15 4. The vehicle driving force control apparatus according to claim 2, further comprising

an acceleration instruction sensor configured to detect an acceleration instruction of the vehicle; and

20 a clutch connection prohibiting section configured to prohibit the output of the clutch connection command by the clutch connection command outputting section, upon the acceleration instruction sensor detecting the acceleration instruction of the vehicle, regardless of the vehicle stop determining section determining whether the vehicle has stopped.

25 5. The vehicle driving force control apparatus according to claim 2, further comprising

a brake operation amount sensor configured to detect a brake operation amount of the vehicle;

30 a brake operation change amount determining section configured to determine whether a change in the brake operation amount per unit time is at least equal to a prescribed value, using the brake operation amount detected by the brake operation amount sensor; and

a clutch connection prohibiting section configured to prohibit the clutch connection by the clutch connection command outputting section, upon the brake operation change amount determining section determining that the change in the brake operation amount per unit time is at least equal to the prescribed value, regardless of the
5 vehicle stop determining section determining whether the vehicle has stopped.

6. The vehicle driving force control apparatus according to claim 2, wherein
the clutch stop determining section is further configured to modify the first and
second amounts of time estimated by the input and output stop estimating sections to take
10 into account a response delay time of the clutch.

7. The vehicle driving force control apparatus according to claim 1, further
comprising
an acceleration slippage detection section configured to detect if acceleration
15 slippage is occurring in a drive wheel that is driven by a vehicle drive source; and
a generator control section configured to control a generation load torque of a
generator to substantially correspond to an acceleration slippage magnitude of the drive
wheel, when the acceleration slippage detection section estimates acceleration slippage
occurring in the drive wheel.
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8. The vehicle driving force control apparatus according to claim 1, further
comprising
a drive mode selection section configured to select one of a multi-wheel drive
mode in which at least the wheel driven by the drive source connected through the clutch
25 is driven and at least one other drive wheel is driven by a drive source not connected by
the clutch, and a non-all wheel drive mode in which at least the clutch disconnects the
drive source connected the wheel through the clutch, while the vehicle is traveling; and
the clutch connection command outputting section being further configured to
output the clutch connection command to connect the clutch when the multi-wheel drive
30 mode has been designated.

9. A vehicle driving force control apparatus for a vehicle having a clutch installed in a torque transfer path from a drive source to a wheel, the clutch having an input part connected to the drive source and an output part connected to the wheel, the vehicle driving force control apparatus comprising:

5 output rotational speed detecting means for detecting an output rotational speed of the output part of the clutch and produce an output rotational speed value;

 input rotational speed detecting means for detecting an input rotational speed of the input part of the clutch and produce an input rotational speed value;

10 output stop estimating means for estimating that rotation of the output part has stop rotating upon an occurrence of a detected first parameter that is based on the output rotational speed value received from the output rotational speed detecting means;

 input stop estimating means for estimating that rotation of the input part has stop rotating upon an occurrence of a detected second parameter that is based on the input rotational speed value received from the input rotational speed detecting means;

15 vehicle stop determining means for determining whether the vehicle has stopped;
 clutch stop determining means for determining that the clutch has stopped rotating based on a determination of the occurrences of the detected output and input parameters, upon the vehicle stop determining means determining that the vehicle has stopped; and
 clutch connection command outputting means for outputting a clutch connection
20 command to connect the clutch, upon the clutch stop determining means determining that the clutch has stopped rotating.

10. The vehicle driving force control apparatus according to claim 9, wherein
 the output stop estimating means is further configured such that the detected first
25 parameter is a first amount of time that is an estimated of time for the output part to stop
 rotating based on the output rotational speed value received from the output rotational
 speed detecting means;

 the input stop estimating means is further configured such that the detected second
30 parameter is a second amount of time that is an estimated of time for the input part to stop
 rotating based on the input rotational speed value received from the input rotational speed
 detecting means; and

the clutch stop determining section is further configured such that the clutch has been determined to have stopped rotating based on the first and second amounts of time estimated by the output and input stop estimating means having elapsed, upon the vehicle stop determining means determining that the vehicle has stopped.

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11. A vehicle driving force controlling method for a vehicle having a clutch installed in a torque transfer path from a drive source to a wheel, the clutch having an input part connected to the drive source and an output part connected to the wheel, the method comprising:

10 detecting an output rotational speed of the output part of the clutch and produce an output rotational speed value;

detecting an input rotational speed of the input part of the clutch and produce an input rotational speed value;

estimating that the rotation of the output part has stop rotating upon an occurrence 15 of a detected first parameter that is based on the output rotational speed value;

estimating that the rotation of the input part has stop rotating upon an occurrence of a detected second parameter that is based on the input rotational speed value;

determining whether a vehicle has stopped;

determining that the clutch has stopped rotating based on a determination of the 20 occurrences of the detected output and input parameters, upon determining that the vehicle has stopped; and

outputting a clutch connection command to connect the clutch, upon determining that the clutch has stopped rotating.

25 12. The vehicle driving force control apparatus according to claim 11, wherein the estimating of the output part has stopped rotating is conducted by estimating a first amount of time as the detected first parameter that is an estimate of the output part stopping rotation based on the output rotational speed value;

the estimating of the input part has stopped rotating is conducted by estimating a 30 second amount of time as the detected second parameter that is an estimate of the input part stopping rotation based on the input rotational speed value; and

the determining that the clutch stopped rotating based on the first and second amounts of time having elapsed, upon determining that the vehicle has stopped.

13. A vehicle driving force control apparatus for a vehicle having at least one
5 first drive wheel and at least one second drive wheel, the vehicle driving force control apparatus comprising:
 - a first drive source configured to transmit a first drive torque the first drive wheel;
 - a clutch installed in a torque transfer path formed between the first drive source and the first drive wheel, the clutch having an input part connected to the first drive source
10 and an output part connected to the first drive wheel;
 - an output rotational speed sensor configured to detect an output rotational speed of the output part of the clutch and produce an output rotational speed value;
 - an input rotational speed sensor configured to detect an input rotational speed of the input part of the clutch and produce an input rotational speed value;
- 15 an output stop estimating section configured to estimate that rotation of the output part has stop rotating upon an occurrence of a detected first parameter that is based on the output rotational speed value received from the output rotational speed sensor;
- an input stop estimating section configured to estimate that rotation of the input part has stop rotating upon an occurrence of a detected second parameter that is based on
20 the input rotational speed value received from the input rotational speed sensor;
- a vehicle stop determining section configured to a determination whether the vehicle has stopped;
 - a clutch stop determining section configured to determine that the clutch has stopped rotating based on a determination of the occurrences of the detected output and
25 input parameters, upon the vehicle stop determining section determining that the vehicle has stopped; and
 - a clutch connection command outputting section configured to output a clutch connection command to connect the clutch, upon the clutch stop determining section determining that the clutch has stopped rotating.

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14. The vehicle driving force control apparatus according to claim 13, wherein

the output stop estimating section is further configured such that the detected first parameter is a first amount of time that is an estimated of time for the output part to stop rotating based on the output rotational speed value received from the output rotational speed sensor;

5 the input stop estimating section is further configured such that the detected second parameter is a second amount of time that is an estimated of time for the input part to stop rotating based on the input rotational speed value received from the input rotational speed sensor; and

10 the clutch stop determining section is further configured such that the clutch has been determined to have stopped rotating based on the first and second amounts of time estimated by the output and input stop estimating sections having elapsed, upon the vehicle stop determining section determining that the vehicle has stopped.

15. The vehicle driving force control apparatus according to claim 14, wherein
15 the vehicle stop determining section further configured to determine that the vehicle has stopped rotating if the output rotational speed value of the output part falls below a minimum detectable rotational speed for the output rotational speed sensor.

16. The vehicle driving force control apparatus according to claim 14, further
20 comprising

an acceleration instruction sensor configured to detect an acceleration instruction of the vehicle; and

25 a clutch connection prohibiting section configured to prohibit the output of the clutch connection command by the clutch connection command outputting section, upon the acceleration instruction sensor detecting the acceleration instruction of the vehicle, regardless of the vehicle stop determining section determining whether the vehicle has stopped.

17. The vehicle driving force control apparatus according to claim 14, further
30 comprising

a brake operation amount sensor configured to detect a brake operation amount of the vehicle;

- a brake operation change amount determining section configured to determine whether a change in the brake operation amount per unit time is at least equal to a prescribed value, using the brake operation amount detected by the brake operation amount sensor; and
- 5 a clutch connection prohibiting section configured to prohibit the clutch connection by the clutch connection command outputting section, upon the brake operation change amount determining section determining that the change in the brake operation amount per unit time is at least equal to the prescribed value, regardless of the vehicle stop determining section determining whether the vehicle has stopped.
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18. The vehicle driving force control apparatus according to claim 14, wherein the clutch stop determining section is further configured to modify the first and second amounts of time estimated by the input and output stop estimating sections to take into account a response delay time of the clutch.
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19. The vehicle driving force control apparatus according to claim 13, further comprising
- an acceleration slippage detection section configured to detect if acceleration slippage is occurring in a second drive wheel that is driven by a second drive source; and
- 20 a generator control section configured to control a generation load torque of a generator to substantially correspond to an acceleration slippage magnitude of the second drive wheel, when the acceleration slippage detection section estimates acceleration slippage occurring in the second drive wheel.
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20. The vehicle driving force control apparatus according to claim 13, further comprising
- a drive mode selection section configured to select one of a multi-wheel drive mode in which at least the first wheel driven by the first drive source connected through the clutch is driven and at least one second drive wheel is driven by a second drive source not connected by the clutch, and a non-all wheel drive mode in which at least the clutch disconnects the drive source connected the first wheel through the clutch, while the vehicle is traveling; and

the clutch connection command outputting section being further configured to output the clutch connection command to connect the clutch when the multi-wheel drive mode has been designated.

5 21. The vehicle driving force control apparatus according to claim 13, further comprising

a second drive source configured to transmit a second drive torque to the second drive wheel and a torque to a generator that supplies electrical power to the first drive source.